CHAPTER 8

THE OZONE LAYER

This chapter focuses on the theme of ozone **depletion**. The 50-minute lesson begins with a warm-up activity in which students explore the phrase "**ozone layer**". Then, working in pairs, students share their prior knowledge of ozone-related issues by taking a brief *Ozone Quiz*. Students then read and discuss a short article, *All about Ozone,* and re-evaluate their answers to the quiz. Next, students participate in a class discussion that encourages them to reflect more deeply on the problem of ozone depletion. Finally, if time allows, students can write a few sentences summarizing their own ideas about ozone depletion and what, if anything, they feel should be done about it.

Through reading about and discussing the topic of ozone depletion, students improve their language skills as they learn and use new vocabulary and concepts related to the topic. Some teachers may choose to present the activities described in the section on **Classroom Applications** in a single 50-minute lesson. Others may wish to combine the activities with some of the materials outlined in the section on **Internet Resources** to create a longer lesson or a unit of several related lessons.

BACKGROUND INFORMATION

Ozone Depletion

The ozone layer is a thin shield in the upper atmosphere that protects life on Earth from the sun's **ultraviolet (UV) rays**. In the 1980s, scientists discovered that the ozone layer was being **depleted**. This depletion allows more UV **radiation** to reach the Earth's surface. This is dangerous because overexposure to UV radiation can lead to very serious health problems, such as skin **cancer** and **cataracts.**

"Good" and "Bad" Ozone

Ozone naturally occurs in two layers of the **atmosphere**: the **troposphere** and the **stratosphere**. The troposphere is the layer that surrounds the Earth's surface. The ground-level ozone in the troposphere is "bad" ozone. It is an air pollutant and contributes to urban **smog**. The stratosphere is above the troposphere. The ozone in the stratosphere is "good" ozone. It protects life on Earth by absorbing some of the sun's UV rays. When people talk about the "ozone layer," they are usually referring to the "good" ozone in the stratosphere, which lies between 10 and 20 miles (15 and 30 kilometers) above the Earth.

The Causes of Ozone Depletion

Until recently, **chlorofluorocarbons** (CFCs) were used widely in industry and elsewhere as **refrigerants**, **insulating foams**, and **solvents**. In fact, they are still widely used in air conditioners, refrigerators, and in some kinds of plastics. Strong winds carry CFCs into the stratosphere in a process that can take as long as 2 to 5 years. When CFCs break down in the stratosphere, they release **chlorine**, which attacks ozone.

What is Being Done About the Problem?

Countries around the world have recognized the problem of ozone depletion. In 1987 governments around the world signed a treaty called the Montreal Protocol to **phase out** the production and use of **ozone-depleting substances**.

Preliminary Lesson Planning

Materials Preparation:

- Duplicate enough copies of the Ozone Quiz in **Appendix A** to give one to each student.
- Duplicate enough copies of the article All About Ozone in **Appendix B** to give one to each student.

Vocabulary Considerations:

Before using the Ozone Quiz and the article All about Ozone, consider what vocabulary students will need to know in order to carry out the lesson successfully. Determine which vocabulary items students are already familiar with, and which will be new to them. Some important terms and their definitions are included in the **glossary**.

WARM-UP ACTIVITY (APPROXIMATELY 10 MINUTES)

Purpose:

- To stimulate students' interest in the topic of ozone depletion
- To activate students' background knowledge about the topic
- To allow students to express their ideas about the importance of the ozone layer
- To introduce and review key vocabulary related to the topic

Procedures:

1. Write the phrase "the ozone layer" on the board. Ask the class what they think the phrase means.
2. As student volunteers give their answers, write key words from their responses on the board.
3. Ask students if they can give some reasons why the ozone layer is important.
4. As volunteers suggest different reasons, list their answers on the board.
5. Ask students if they can name some reasons the ozone layer is in trouble.
6. As students suggest reasons, list their answers on the board.

ACTIVITY #1 (APPROXIMATELY 10 MINUTES)

Purpose:

- To increase interest in and awareness of the problem of ozone depletion
- To give students an opportunity to share their prior knowledge of ozone-related issues
- To practice reading
- To stimulate discussion

Procedure:

1. Divide the class into pairs and distribute copies of the Ozone Quiz.
2. Explain to the students that they are going to take a quiz to find out what they already know about ozone. Tell them they will not be graded on the quiz. The purpose of the quiz is to let them find out for themselves what they already know about ozone.
3. Make sure the students understand the questions.
4. Working in pairs, students discuss the questions and mark their answers.
5. Next, ask for student volunteers to take turns reading and reporting their answers to the questions. As volunteers report, write their answers (**T**, **F**, or **U**) on the board. If any students disagree with the answers given, ask them to report their answers. Include those answers on the board but do not indicate whether any of the students' answers are right or wrong. (Note: Do not erase the quiz answers on the board. You will come back to them at the end of the next activity.)
6. After students have reported their answers to all ten questions on the quiz, tell the class they will now have a chance to read an article that provides the correct answers to the questions.

ACTIVITY #2 (APPROXIMATELY 15 MINUTES)

Purpose:

- To allow students an opportunity to assess their prior knowledge of ozone-related issues
- To increase students' knowledge of ozone-related issues
- To give students the opportunity to learn and use key vocabulary and concepts associated with the topic
- To practice reading

Procedure:

1. Explain to the class that they are going to continue working in pairs. Distribute one copy of the article All About Ozone to each student.
2. Tell the students to read the article and discuss it with their partners. They should also refer to the questions on the Ozone Quiz and confirm or modify their original answers as necessary.

3. After pairs have read the article, discussed it with their partners, and reviewed their answers to the Ozone Quiz, ask for volunteers to give their answers to the quiz items. As students report their answers, refer to the board and the list of answers produced in **Activity #1**. As students provide the correct answers, circle them (**T** or **F**) on the board. Encourage students to explain their answers and to read aloud the sentence in the article that confirms their answer. (Answers to the Ozone Quiz are provided in the Answer Key in **Appendix C.**)

COOL DOWN ACTIVITY (APPROXIMATELY 15 MINUTES)

Purpose:

- To conclude the lesson
- To give students an opportunity to reflect on and assess what they have learned
- To allow students to practice listening and speaking skills in a meaningful way

Procedure:

1. Tell the students that they will now have a class discussion and that they should use their background knowledge and opinions, along with what they have learned from the article and quiz, to answer the questions.
2. Conduct a class discussion centered on some or all of the following questions:
    1. Did anything in the quiz surprise you? What and why?
    2. Did anything in the article surprise you? What and why?
    3. What did you learn from the quiz?
    4. What did you learn from the article?
    5. In your opinion, is ozone depletion a problem of worldwide importance? Why or why not?
    6. Do you think ozone depletion is a problem in your own country? Why or why not?
    7. Have you ever seen or bought any products that had a label saying they were "environmentally friendly" or "ozone friendly"? What products? Where did you see or buy them?
    8. Can you suggest any ways of reducing damage to the ozone layer?
    9. What do you think is the best solution to the problem of ozone depletion?
3. (Optional) If time allows, ask students to write a few sentences summarizing their ideas about ozone depletion and what, if anything, they feel should be done about it. Volunteers can read their sentences to the class.

EXTENSIONS

1. Have students create a "news program" about the ozone situation. Students can include information about what the ozone layer is, its importance, the materials and actions that contribute to ozone depletion, and actions people can take to improve the situation. Record the news program on audiotape or videotape.

2. Have students use the Internet to find articles about ozone depletion. Ask them to write a brief summary of one or two of the articles and read their summaries to the class.

3. Have students create a brochure, listing actions people can take to protect the ozone layer and themselves from the dangers of overexposure to ultraviolet radiation.

4. Have students conduct a poll of eight to ten people to find out their answers to the following question: *Are you concerned about the problem of ozone depletion? Why or why not?*

Refer to the **Internet Resources** section for more information and lesson planning ideas.

Ozone Quiz

Read each sentence and circle the letter that shows whether the statement is true (T), false (F), or you are unsure (U) about it.

1. **Ozone** is a gas. T F U

2. All ozone is bad for people's health. T F U

3. The ozone layer is in the part of the atmosphere that is closest to Earth. T F U

4. Ultraviolet (UV) rays can cause skin cancer and other health problems. T F U

5. Chlorine can **damage** ozone. T F U

6. In order to make ozone, UV rays are necessary. T F U

7. The ozone hole is a huge hole in the Earth. T F U

8. The ozone hole was discovered more than one hundred years ago. T F U

9. "Environmentally friendly" products destroy ozone. T F U

10. **Environmentalists** think we need more research to save the ozone layer. T F U

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All About Ozone

The Ozone Layer

Between 10 and 20 miles (15 and 30 kilometers) above the Earth is a thin layer of gas called the ozone layer. Ozone at ground level is dangerous to breathe, but miles up in the sky it protects the Earth from the dangerous, ultraviolet rays (UV rays) of the sun. UV rays cause skin cancer, cataracts, and other health problems.

A Natural Cycle

UV rays are needed to make ozone. So in parts of the world where there is more sunlight, there is more ozone in the atmosphere. This natural cycle worked very well until human-made chemicals began to destroy the ozone.

Ozone Destroyers

Chlorine is the main destroyer of ozone. In industry, chlorine is mixed with other chemicals to make chlorofluorocarbons (CFCs). In nature, chlorine mixes with other chemicals to make **chloromethane**. CFCs are used in **aerosols**, refrigerators, car air-conditioners, and in making some kinds of plastics. Chloromethane is released by **rotting** **vegetation**, **manure**, and **indigestible** gases.

The Ozone Hole

In 1985 scientists discovered a huge "hole" in the ozone layer above **Antarctica**. If the hole gets bigger and ozone continues to be depleted, there are great dangers. Many more people will get skin cancer from exposure to UV rays. Also, the UV rays will add to **global warming** caused by the **greenhouse effect**.

Ozone Depletion in the Arctic

Ozone depletion is a problem in Arctic too. In 1997 satellites showed that ozone levels over the **North Pole** were 40 percent lower than what they had been in 1982. However, the loss near the North Pole is not as serious as it is over the **South Pole**.

Reducing CFCs

Since the late 1980s, steps have been taken to reduce the use of chemicals and gases that destroy the ozone layer. Ninety countries have already agreed to phase out CFCs. You may have seen products carrying "environmentally friendly" or "ozone friendly" labels to show that they do not contain CFCs. DuPont, the world's largest maker of air-conditioners and refrigerators, has developed new chemicals that do 90 percent less harm than CFCs, but environmentalists say that is not good enough. They say we need more research to find chemicals that are totally safe.

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Answer Key: Ozone Quiz

1. T

2. F (Ozone at ground level is bad for people's health, but ozone is the stratosphere protects people from the dangerous ultraviolet rays of the sun.

3. F (The ozone layer is in the stratosphere, 10 to 20 miles above the Earth.)

4. T

5. T

6. T

7. F (The ozone hole is a huge hole in ozone layer, in the upper atmosphere above Antarctica.)

8. F (Scientists discovered the ozone hole in 1985.)

9. F ("Environmentally friendly" products protect ozone.)

10. T

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